Fig.1

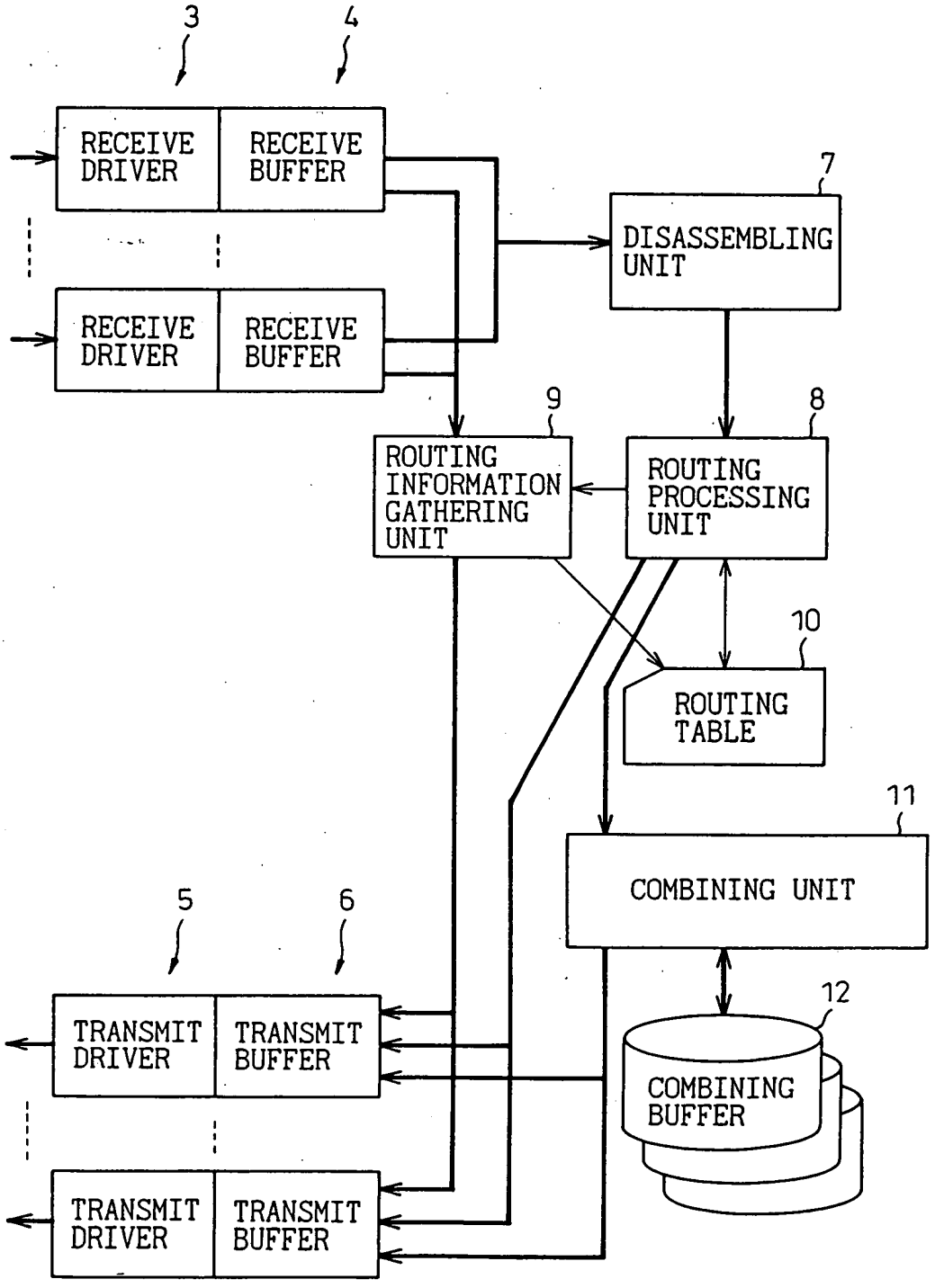

3
4
RECEIVE DRIVER
RECEIVE BUFFER
RECEIVE DRIVER
RECEIVE BUFFER
7
DISASSEMBLING UNIT
9
8
ROUTING INFORMATION GATHERING UNIT
ROUTING PROCESSING UNIT
10
ROUTING TABLE
11
COMBINING UNIT
5
6
TRANSMIT DRIVER
TRANSMIT BUFFER
TRANSMIT DRIVER
TRANSMIT BUFFER
12
COMBINING BUFFER

Fig.2

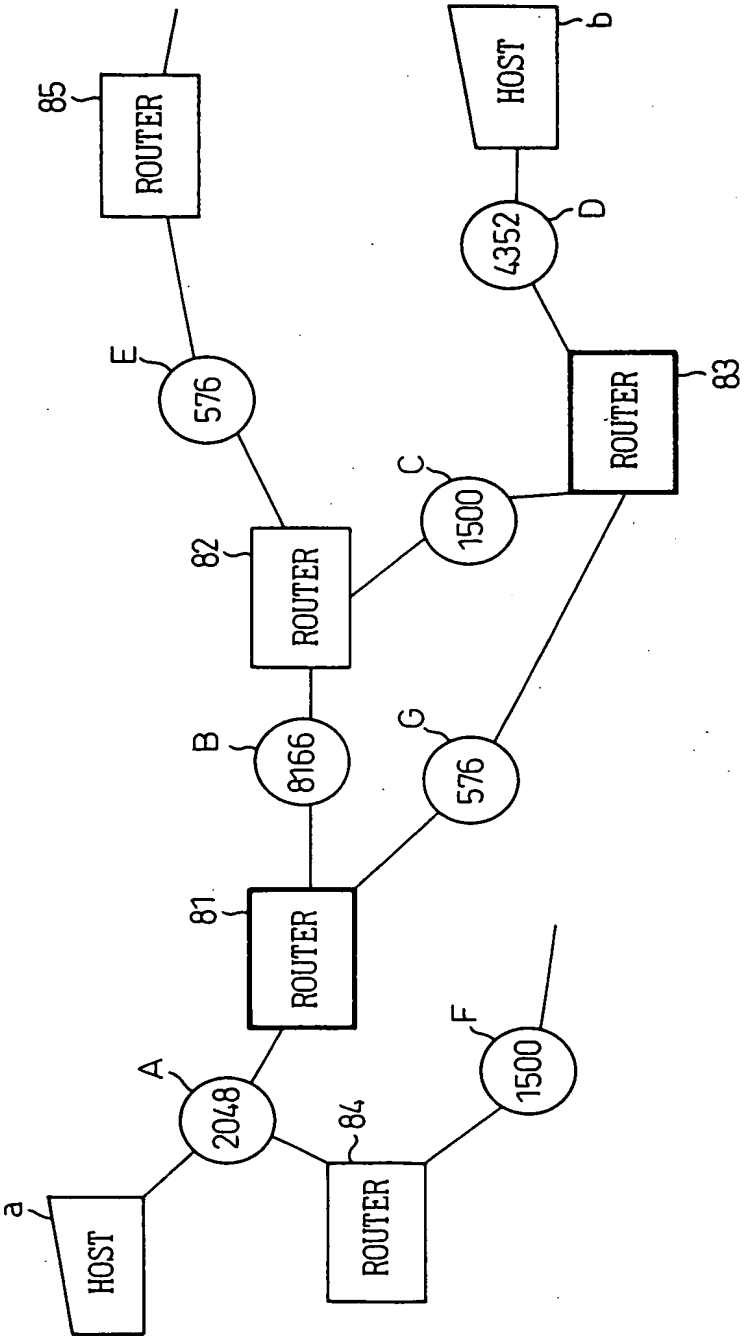

HOST
a
2048
A
ROUTER
81
8166
B
ROUTER
82
576
E
ROUTER
85
HOST
b
4352
D
ROUTER
83
1500
C
576
G
ROUTER
84
1500
F

Fig.3

ROUTING TABLE IN ROUTER 81

NETWORK	NEXT HOP ROUTER	DISTANCE	TRANSMISSION PATH MTU	COMBINED PACKET	DISASSEM-BLING ROUTER
D	82	2	1500	ACCEPTABLE	83
D	83	1	576	ACCEPTABLE	83
⋮	⋮	⋮	⋮	UN-ACCEPTABLE	⋮

Fig.4

ROUTING TABLE IN ROUTER 82

NETWORK	NEXT HOP ROUTER	DISTANCE	TRANSMISSION PATH MTU	COMBINED PACKET	DISASSEM-BLING ROUTER
A	81	1	2048	ACCEPTABLE	81
D	83	1	1500	ACCEPTABLE	83
⋮	⋮	⋮	⋮	UN-ACCEPTABLE	⋮

Fig.5

ROUTING TABLE IN ROUTER 83

NETWORK	NEXT HOP ROUTER	DISTANCE	TRANSMISSION PATH MTU	COMBINED PACKET	DISASSEM-BLING ROUTER
A	82	2	1500	ACCEPTABLE	81
A	81	1	576	ACCEPTABLE	81
⋮	⋮	⋮	⋮	UN-ACCEPTABLE	⋮

Fig.6

NETWORK ADDRESSES OF NETWORKS

NETWORK	NETWORK ADDRESS	SUBNET MASK
A	10. 100. 0. 0	255. 255. 0. 0
B	10. 0. 0. 0	255. 0. 0. 0
C	20. 0. 0. 0	255. 0. 0. 0
D	20. 210. 0. 0	255. 255. 0. 0
E	20. 200. 0. 0	255. 255. 0. 0
F	10. 100. 1. 0	255 255 255. 0
G	30. 0. 0. 0	255. 0. 0. 0

Fig.7

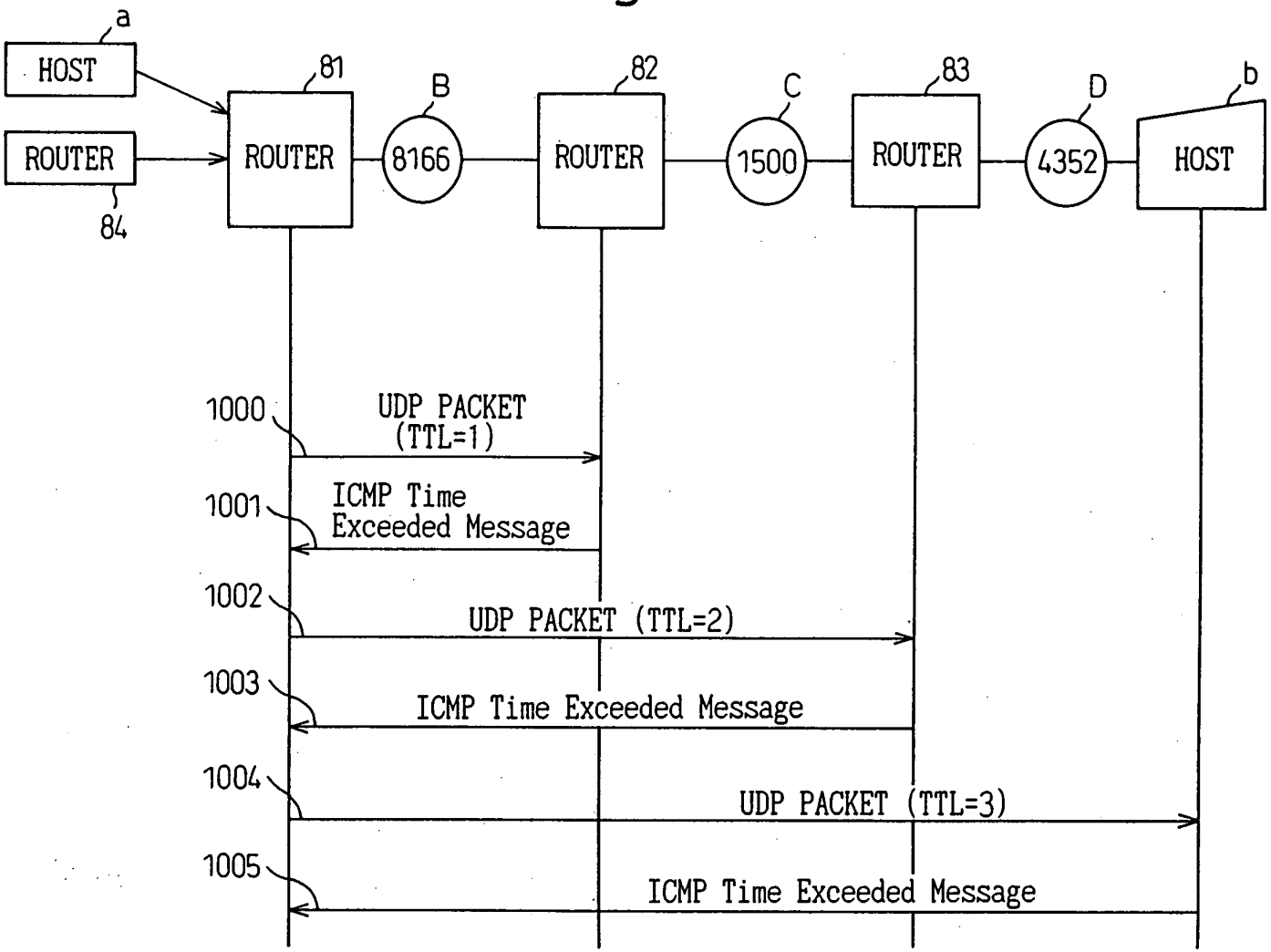


Fig.8

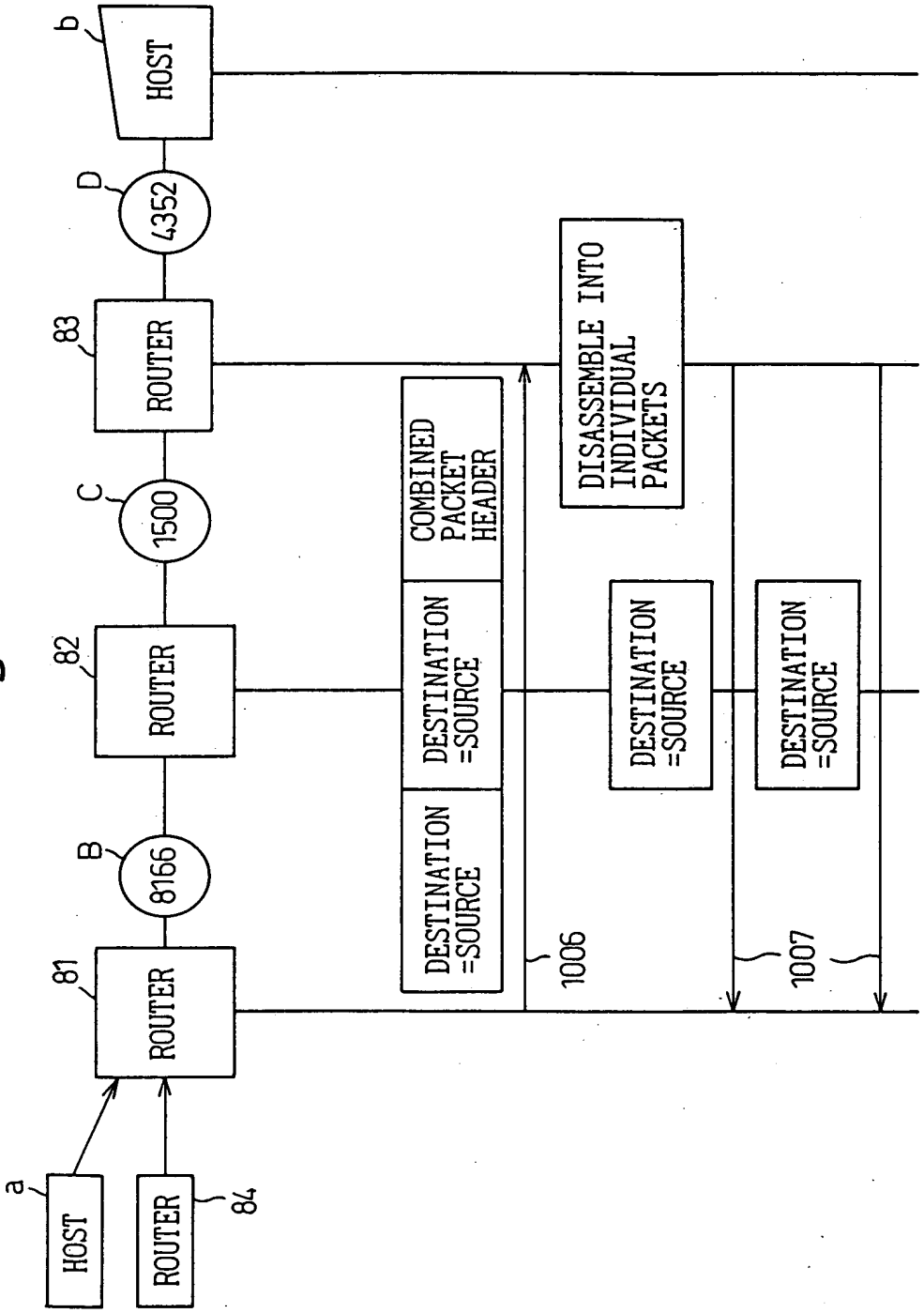

a
HOST
ROUTER
84
81
ROUTER
B
8166
82
ROUTER
C
1500
83
ROUTER
D
4352
b
HOST
DESTINATION =SOURCE
DESTINATION =SOURCE
COMBINED PACKET HEADER
DISASSEMBLE INTO INDIVIDUAL PACKETS
1006
1007

Fig.9

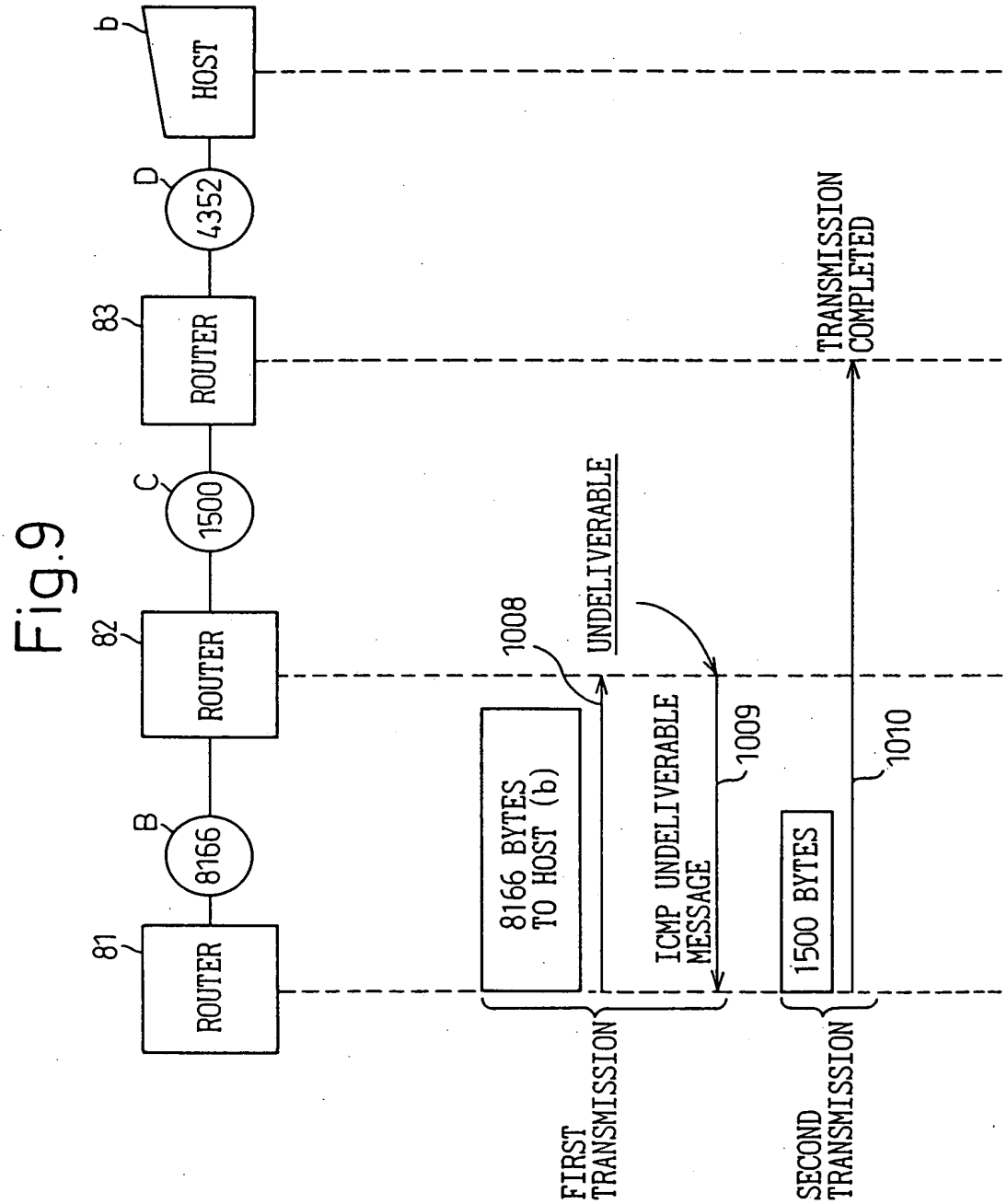

ROUTER
81
8166
B
ROUTER
82
1500
C
ROUTER
83
4352
D
HOST
b
8166 BYTES TO HOST (b)
1008
UNDELIVERABLE
ICMP UNDELIVERABLE MESSAGE
1009
1500 BYTES
1010
TRANSMISSION COMPLETED
FIRST TRANSMISSION
SECOND TRANSMISSION

Fig.10

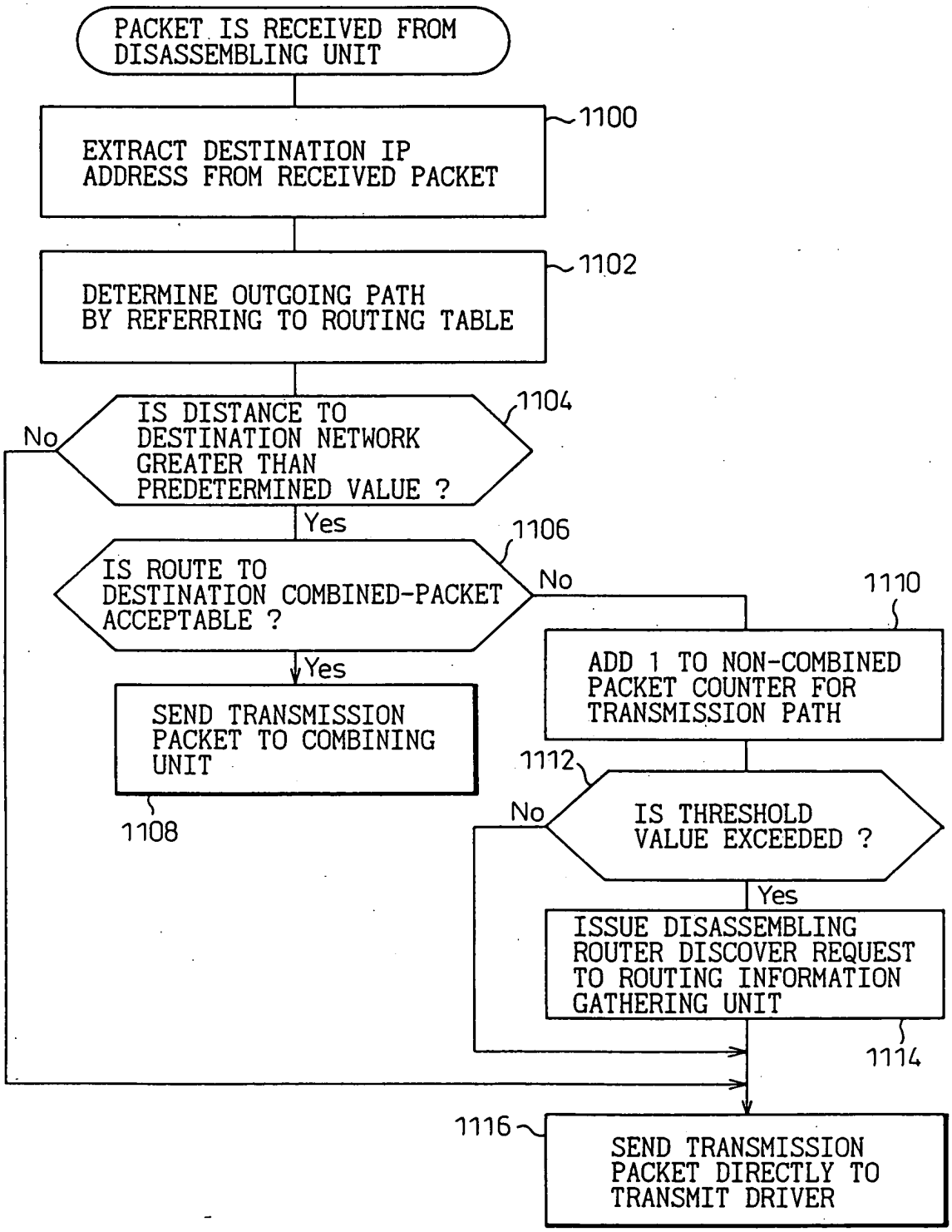

PACKET IS RECEIVED FROM DISASSEMBLING UNIT
1100
EXTRACT DESTINATION IP ADDRESS FROM RECEIVED PACKET
1102
DETERMINE OUTGOING PATH BY REFERRING TO ROUTING TABLE
1104
IS DISTANCE TO DESTINATION NETWORK GREATER THAN PREDETERMINED VALUE ?
No
Yes
1106
IS ROUTE TO DESTINATION COMBINED-PACKET ACCEPTABLE ?
No
Yes
1110
ADD 1 TO NON-COMBINED PACKET COUNTER FOR TRANSMISSION PATH
1112
IS THRESHOLD VALUE EXCEEDED ?
No
Yes
ISSUE DISASSEMBLING ROUTER DISCOVER REQUEST TO ROUTING INFORMATION GATHERING UNIT
1114
SEND TRANSMISSION PACKET TO COMBINING UNIT
1108
1116
SEND TRANSMISSION PACKET DIRECTLY TO TRANSMIT DRIVER

Fig.11

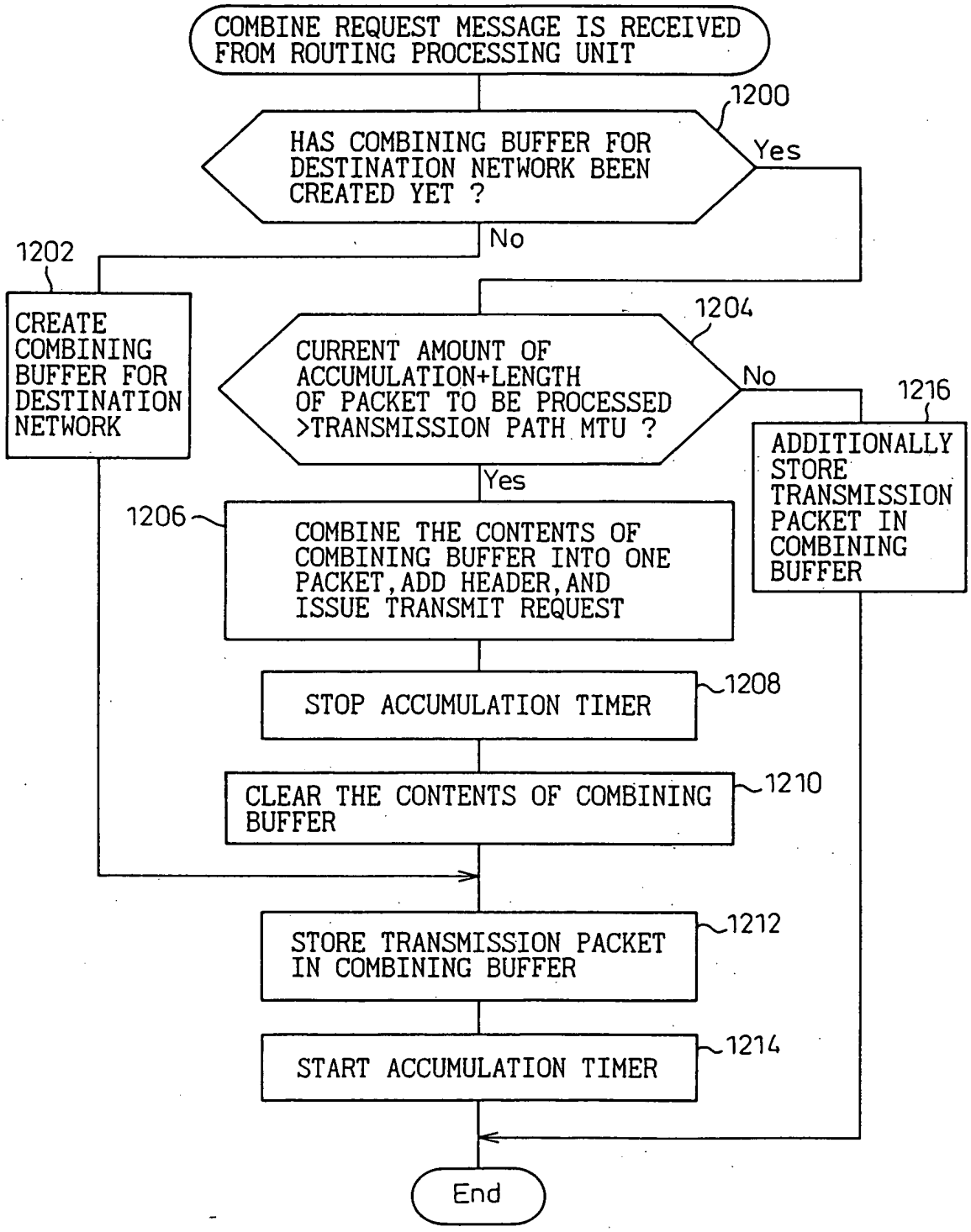

COMBINE REQUEST MESSAGE IS RECEIVED FROM ROUTING PROCESSING UNIT
1200
HAS COMBINING BUFFER FOR DESTINATION NETWORK BEEN CREATED YET ?
Yes
No
1202
CREATE COMBINING BUFFER FOR DESTINATION NETWORK
1204
CURRENT AMOUNT OF ACCUMULATION+LENGTH OF PACKET TO BE PROCESSED >TRANSMISSION PATH MTU ?
No
1216
ADDITIONALLY STORE TRANSMISSION PACKET IN COMBINING BUFFER
Yes
1206
COMBINE THE CONTENTS OF COMBINING BUFFER INTO ONE PACKET, ADD HEADER, AND ISSUE TRANSMIT REQUEST
STOP ACCUMULATION TIMER
1208
CLEAR THE CONTENTS OF COMBINING BUFFER
1210
STORE TRANSMISSION PACKET IN COMBINING BUFFER
1212
START ACCUMULATION TIMER
1214
End

Fig.12

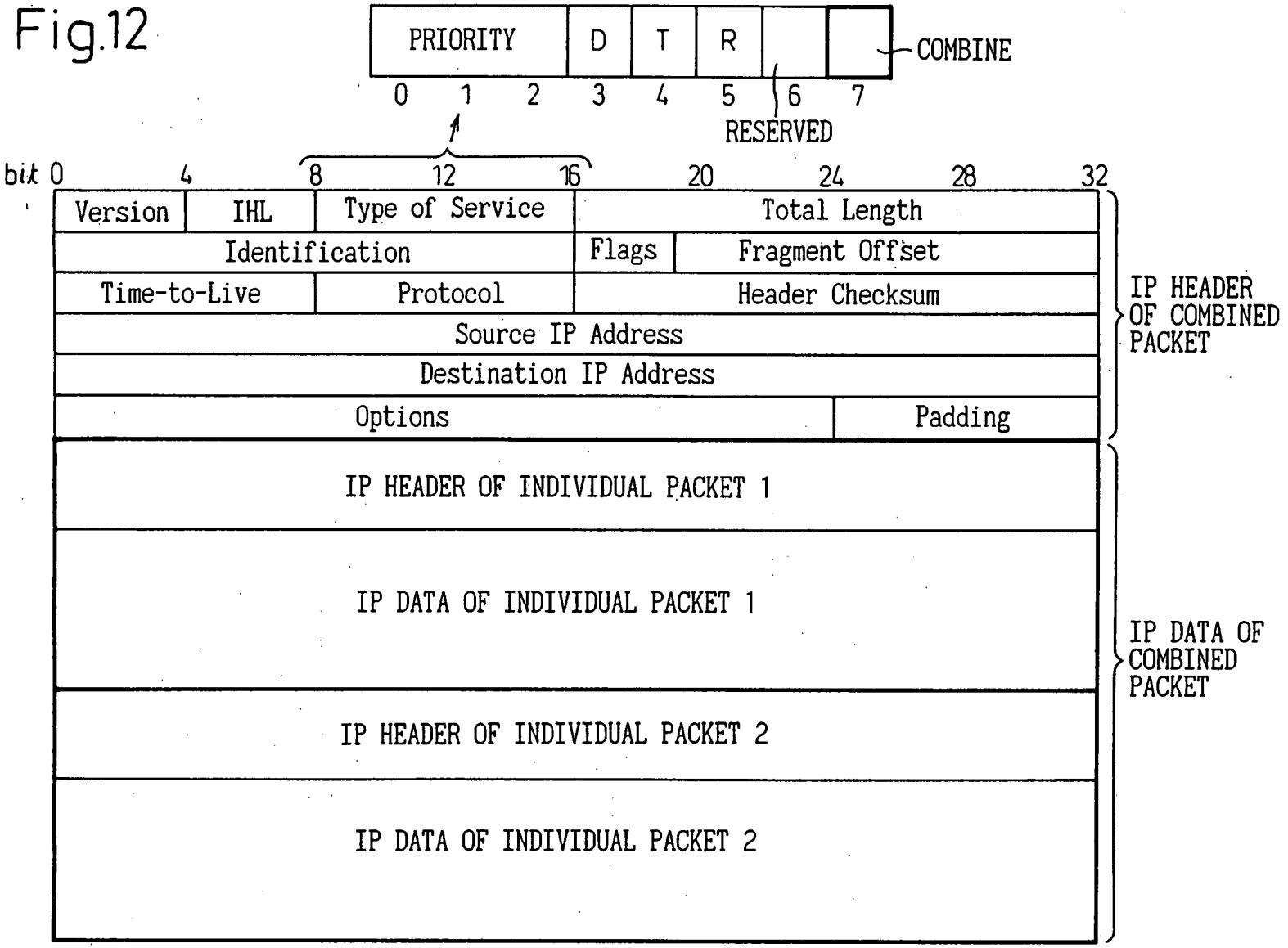

PRIORITY
D
T
R
COMBINE
0 1 2 3 4 5 6 7
RESERVED
bit 0 4 8 12 16 20 24 28 32
Version
IHL
Type of Service
Total Length
Identification
Flags
Fragment Offset
Time-to-Live
Protocol
Header Checksum
Source IP Address
Destination IP Address
Options
Padding
IP HEADER OF COMBINED PACKET
IP HEADER OF INDIVIDUAL PACKET 1
IP DATA OF INDIVIDUAL PACKET 1
IP HEADER OF INDIVIDUAL PACKET 2
IP DATA OF INDIVIDUAL PACKET 2
IP DATA OF COMBINED PACKET

Fig.13

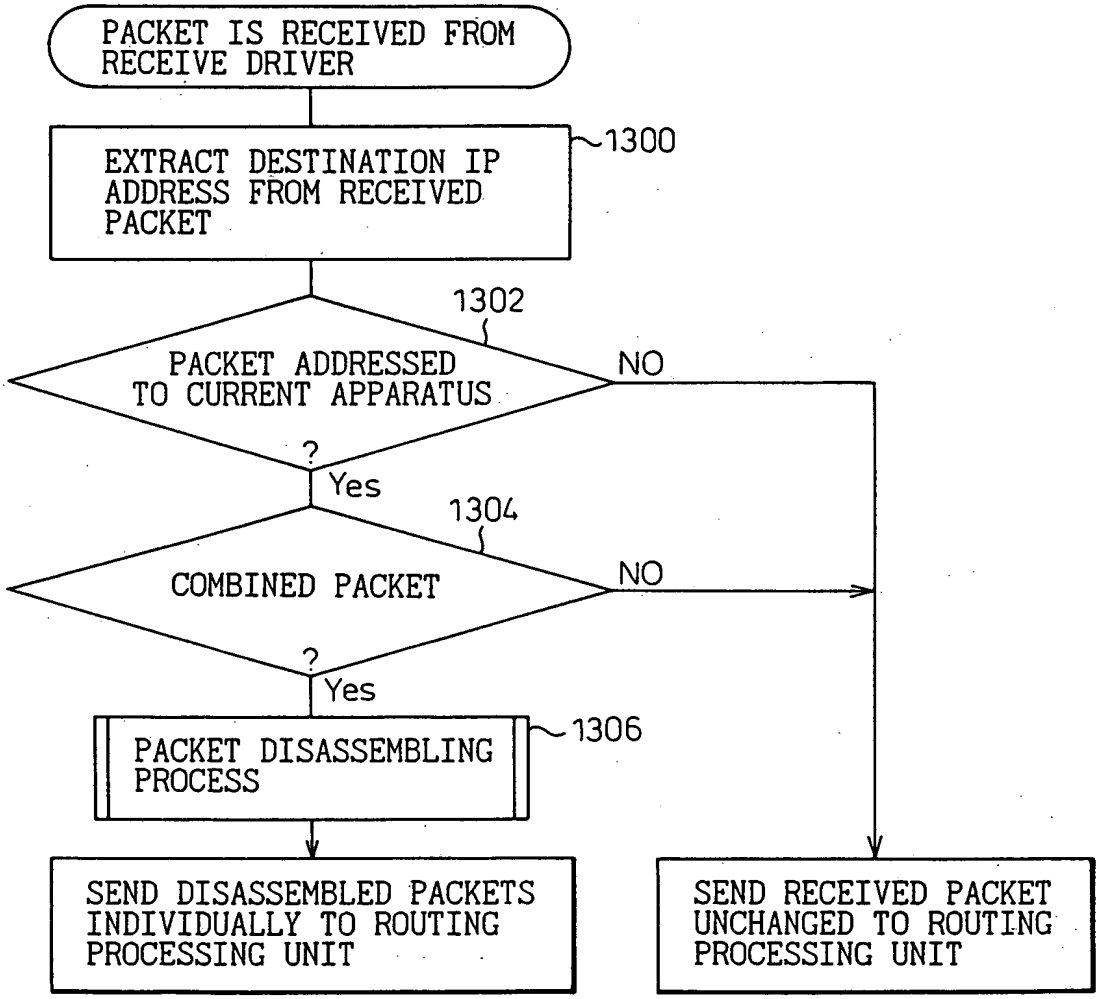

PACKET IS RECEIVED FROM RECEIVE DRIVER
EXTRACT DESTINATION IP ADDRESS FROM RECEIVED PACKET
1300
1302
PACKET ADDRESSED TO CURRENT APPARATUS
NO
?
Yes
1304
COMBINED PACKET
NO
?
Yes
PACKET DISASSEMBLING PROCESS
1306
SEND DISASSEMBLED PACKETS INDIVIDUALLY TO ROUTING PROCESSING UNIT
SEND RECEIVED PACKET UNCHANGED TO ROUTING PROCESSING UNIT

Fig.14

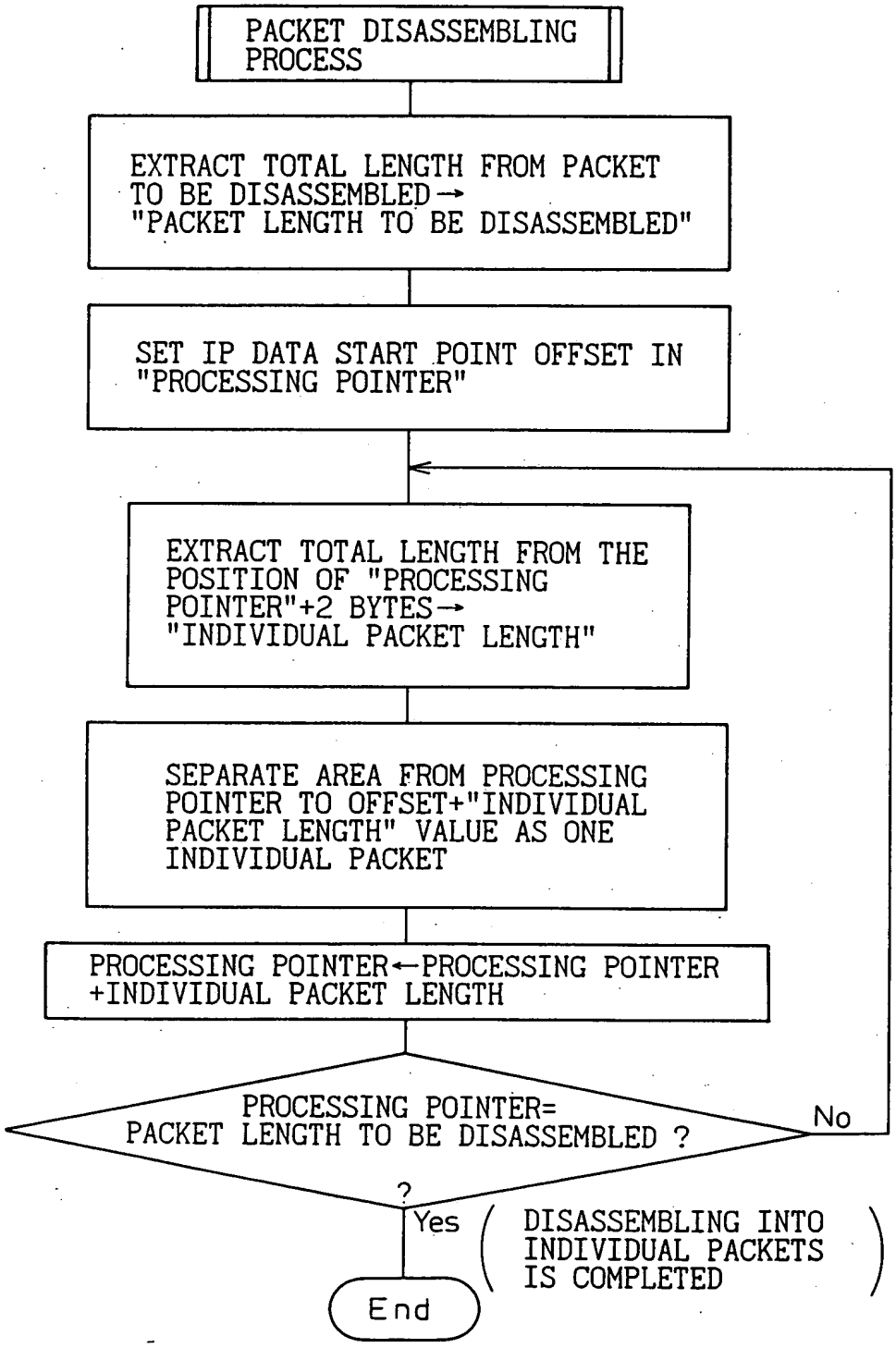

PACKET DISASSEMBLING PROCESS
EXTRACT TOTAL LENGTH FROM PACKET TO BE DISASSEMBLED→ "PACKET LENGTH TO BE DISASSEMBLED"
SET IP DATA START POINT OFFSET IN "PROCESSING POINTER"
EXTRACT TOTAL LENGTH FROM THE POSITION OF "PROCESSING POINTER"+2 BYTES→ "INDIVIDUAL PACKET LENGTH"
SEPARATE AREA FROM PROCESSING POINTER TO OFFSET+"INDIVIDUAL PACKET LENGTH" VALUE AS ONE INDIVIDUAL PACKET
PROCESSING POINTER←PROCESSING POINTER +INDIVIDUAL PACKET LENGTH
PROCESSING POINTER= PACKET LENGTH TO BE DISASSEMBLED ?
No
Yes
DISASSEMBLING INTO INDIVIDUAL PACKETS IS COMPLETED
End

Fig.15

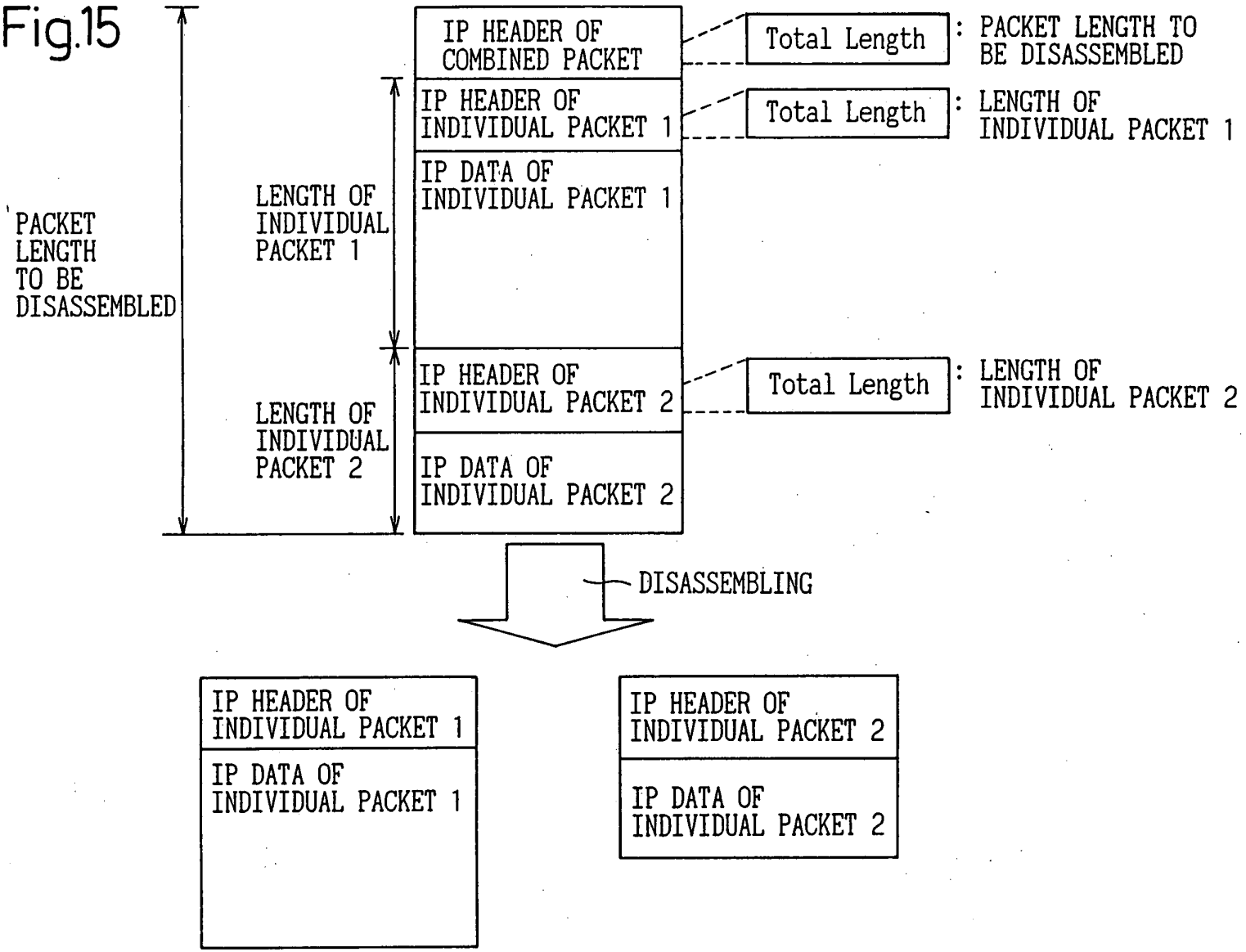

IP HEADER OF COMBINED PACKET
Total Length
: PACKET LENGTH TO BE DISASSEMBLED
IP HEADER OF INDIVIDUAL PACKET 1
Total Length
: LENGTH OF INDIVIDUAL PACKET 1
IP DATA OF INDIVIDUAL PACKET 1
PACKET LENGTH TO BE DISASSEMBLED
LENGTH OF INDIVIDUAL PACKET 1
IP HEADER OF INDIVIDUAL PACKET 2
Total Length
: LENGTH OF INDIVIDUAL PACKET 2
LENGTH OF INDIVIDUAL PACKET 2
IP DATA OF INDIVIDUAL PACKET 2
DISASSEMBLING
IP HEADER OF INDIVIDUAL PACKET 1
IP DATA OF INDIVIDUAL PACKET 1
IP HEADER OF INDIVIDUAL PACKET 2
IP DATA OF INDIVIDUAL PACKET 2

Fig.16

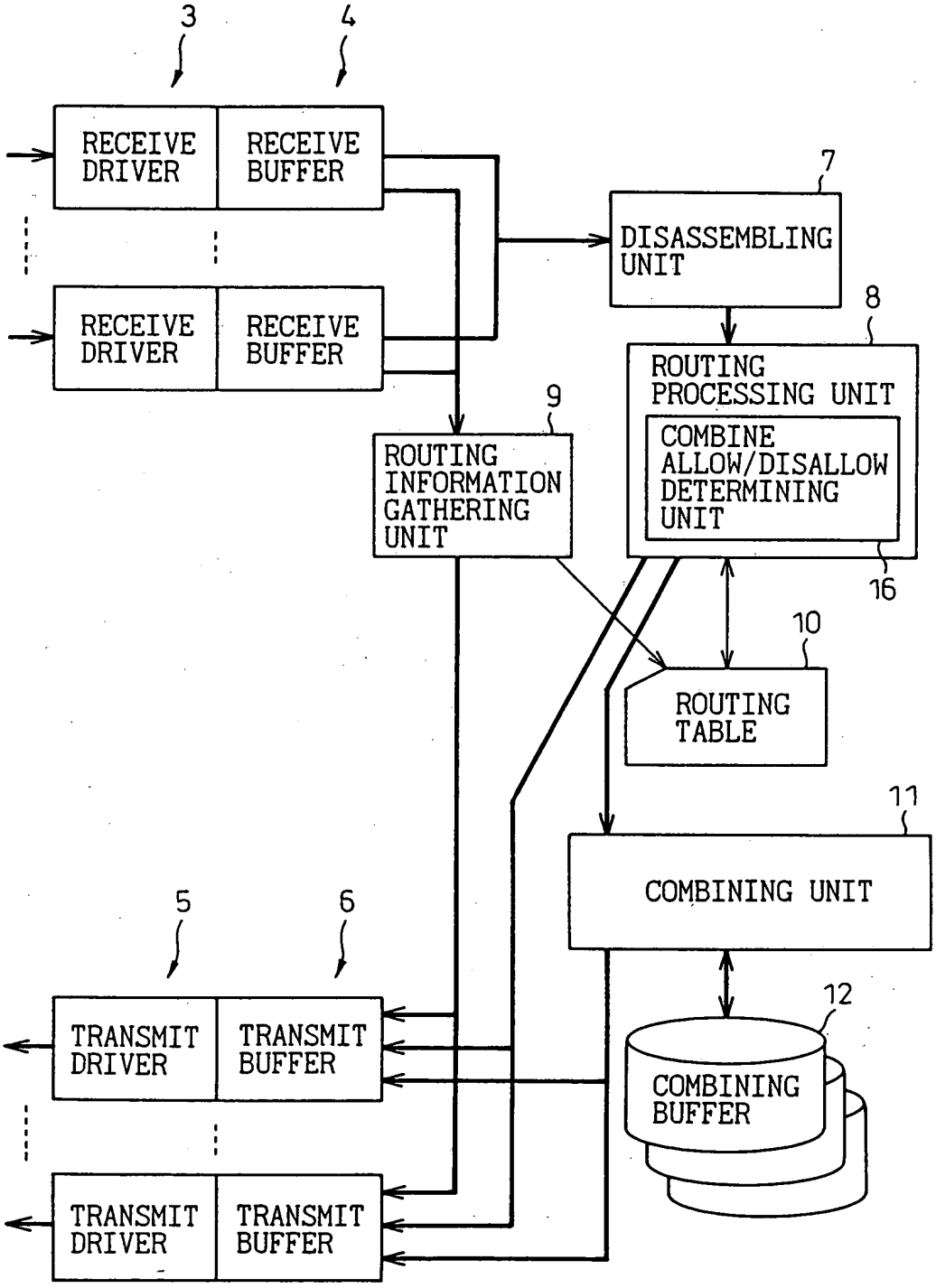

3
4
RECEIVE DRIVER
RECEIVE BUFFER
RECEIVE DRIVER
RECEIVE BUFFER
7
DISASSEMBLING UNIT
8
ROUTING PROCESSING UNIT
COMBINE ALLOW/DISALLOW DETERMINING UNIT
16
9
ROUTING INFORMATION GATHERING UNIT
10
ROUTING TABLE
11
COMBINING UNIT
5
6
TRANSMIT DRIVER
TRANSMIT BUFFER
TRANSMIT DRIVER
TRANSMIT BUFFER
12
COMBINING BUFFER

Fig.17

ROUTING TABLE IN ROUTER 81

NETWORK	NEXT HOP ROUTER	DIS-TANCE	TRANSMISSION PATH MTU	COM-BINED PACKET	DISASSEM-BLING ROUTER	PATH ATTRIBUTE	NETWORK CONDITION
D	82	2	1500	ACCEP-TABLE	83	NON-REAL TIME ROUTE	CONGESTED
D	83	1	576	ACCEP-TABLE	83	REAL TIME ROUTE	NORMAL
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮

Fig.18

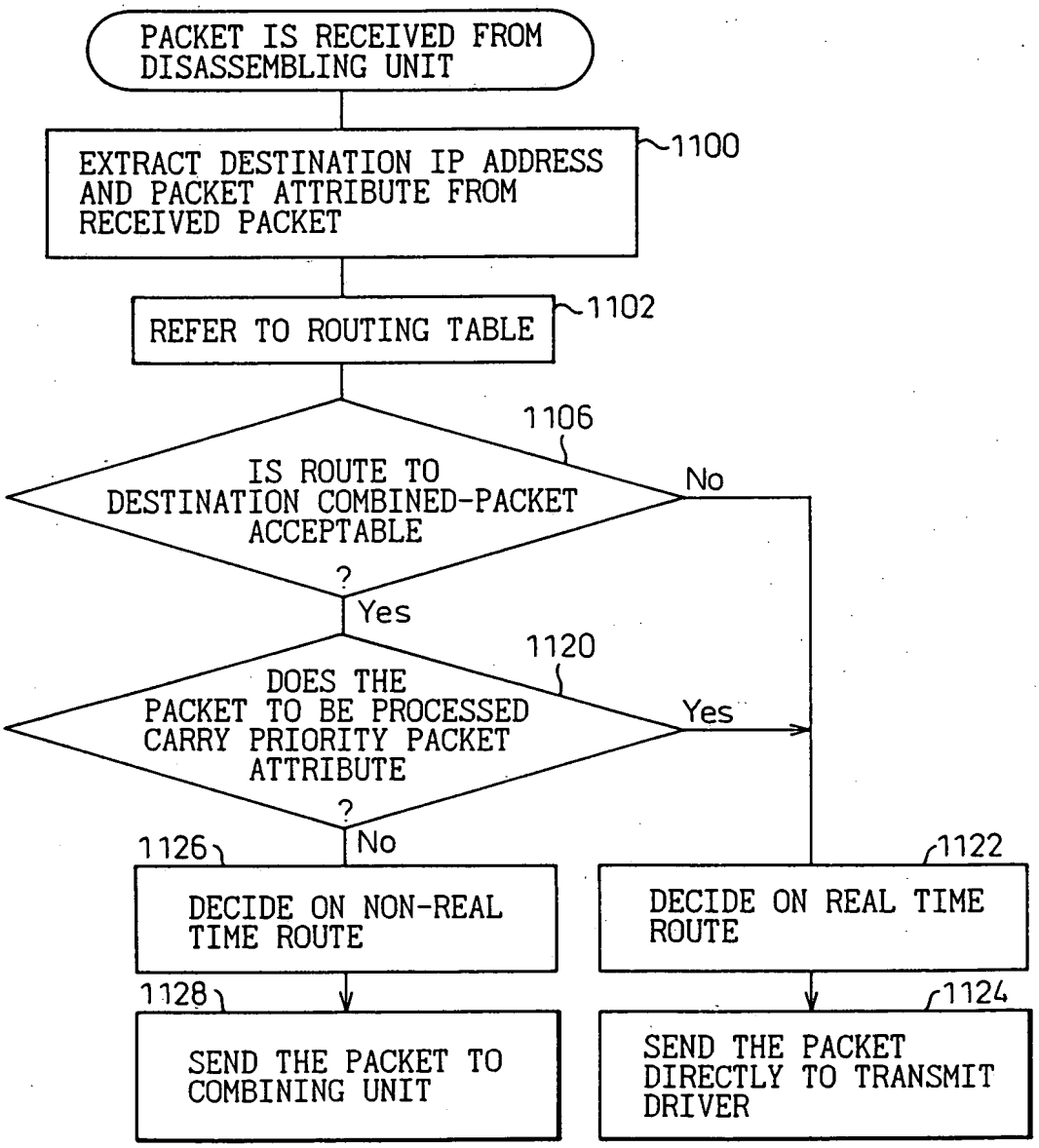

PACKET IS RECEIVED FROM DISASSEMBLING UNIT
EXTRACT DESTINATION IP ADDRESS AND PACKET ATTRIBUTE FROM RECEIVED PACKET
1100
REFER TO ROUTING TABLE
1102
1106
IS ROUTE TO DESTINATION COMBINED-PACKET ACCEPTABLE ?
No
Yes
1120
DOES THE PACKET TO BE PROCESSED CARRY PRIORITY PACKET ATTRIBUTE ?
Yes
No
1126
DECIDE ON NON-REAL TIME ROUTE
1122
DECIDE ON REAL TIME ROUTE
1128
SEND THE PACKET TO COMBINING UNIT
1124
SEND THE PACKET DIRECTLY TO TRANSMIT DRIVER

Fig.19

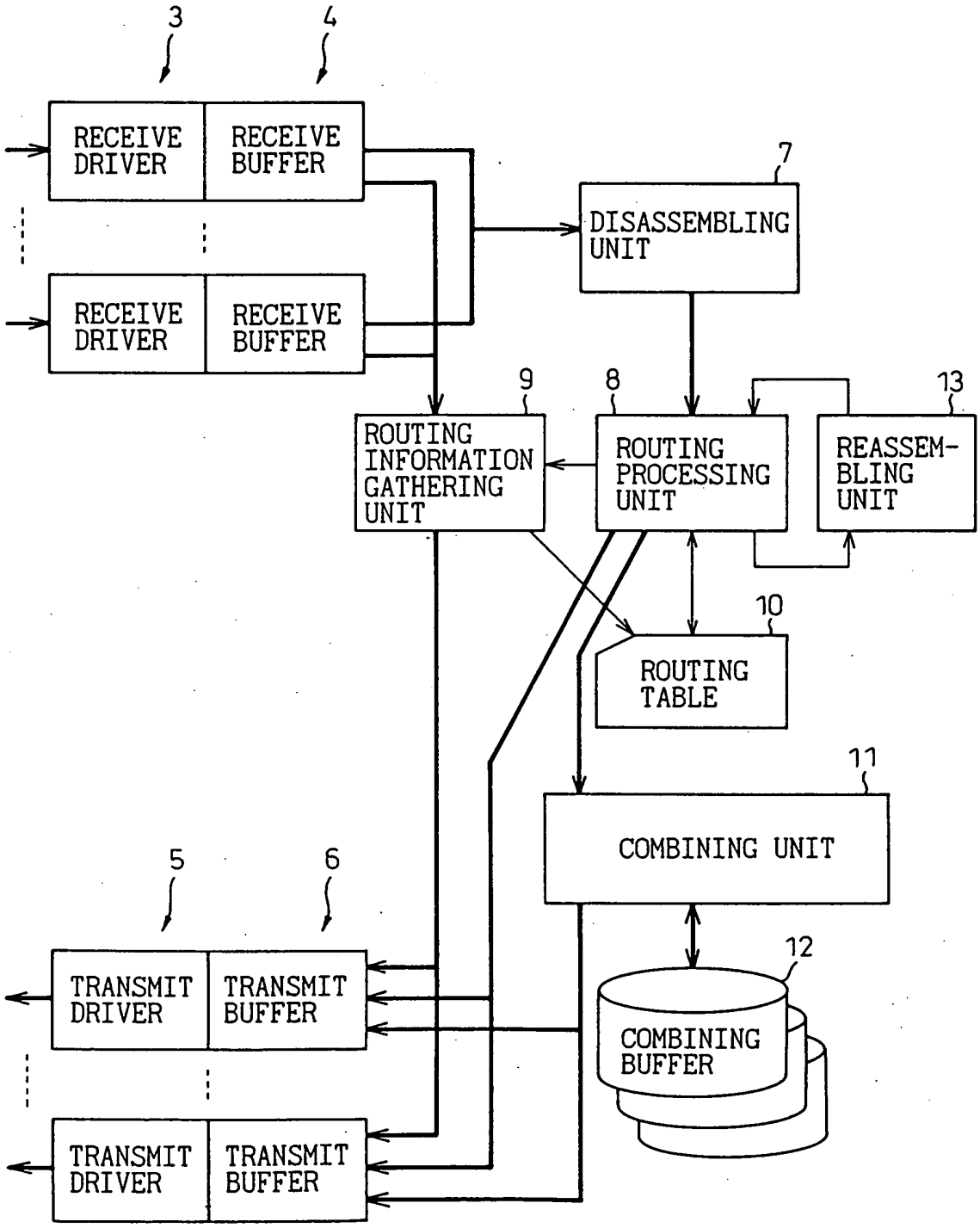

3
4
RECEIVE DRIVER
RECEIVE BUFFER
RECEIVE DRIVER
RECEIVE BUFFER
7
DISASSEMBLING UNIT
9
8
13
ROUTING INFORMATION GATHERING UNIT
ROUTING PROCESSING UNIT
REASSEM-BLING UNIT
10
ROUTING TABLE
11
COMBINING UNIT
5
6
TRANSMIT DRIVER
TRANSMIT BUFFER
TRANSMIT DRIVER
TRANSMIT BUFFER
12
COMBINING BUFFER

Fig.20

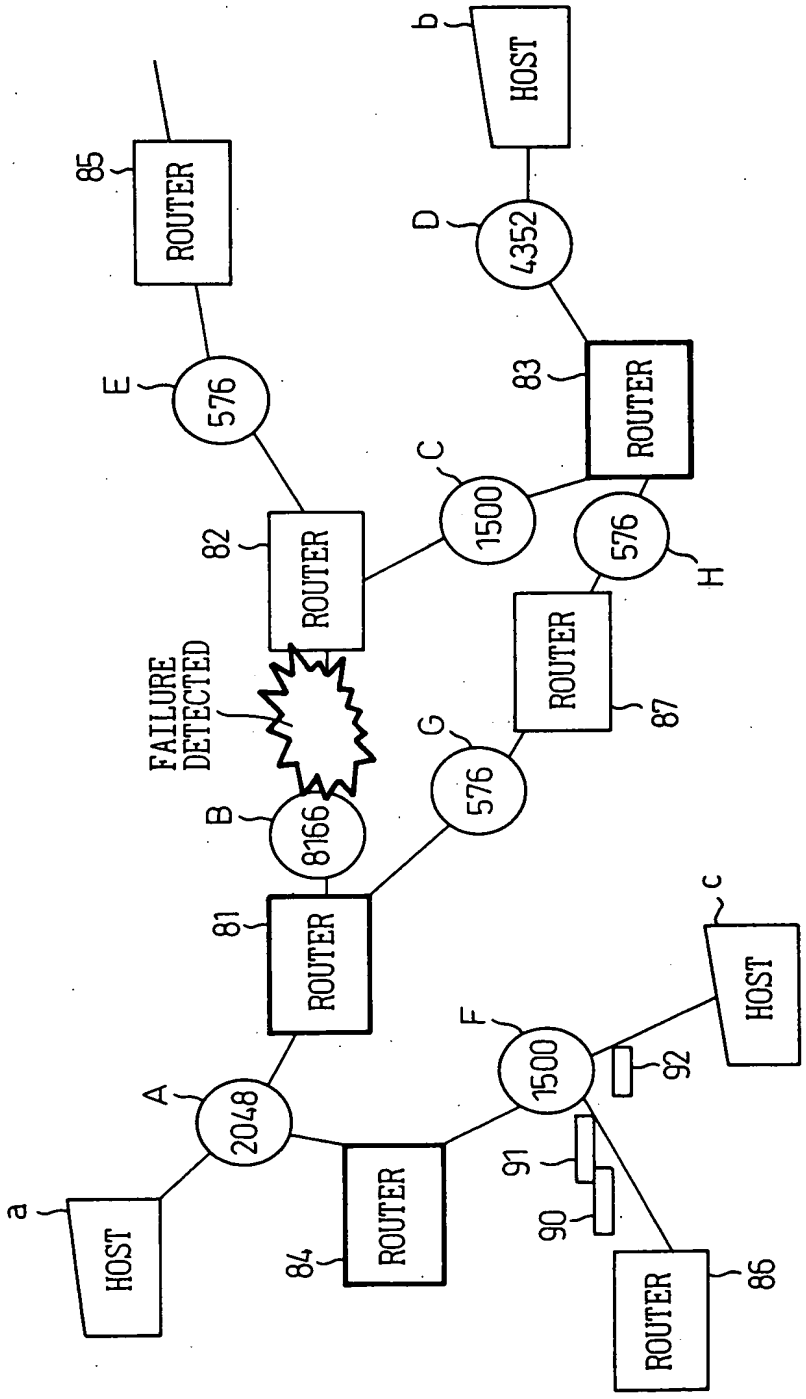

a
HOST
A
2048
81
ROUTER
B
8166
FAILURE
DETECTED
82
ROUTER
E
576
85
ROUTER
C
1500
83
ROUTER
D
4352
b
HOST
H
576
87
ROUTER
G
576
F
1500
91
90
92
c
HOST
84
ROUTER
86
ROUTER

Fig.21

ROUTING TABLE IN ROUTER 84

NETWORK	NEXT HOP ROUTER	DISTANCE	TRANSMISSION PATH MTU	COMBINED PACKET	DISASSEM-BLING ROUTER	NETWORK CONDITION
D	81	3	1500	ACCEPTABLE	83	NORMAL
⋮	⋮	⋮	⋮	⋮	⋮	⋮

Fig.22

ROUTING TABLE IN ROUTER 81

NETWORK	NEXT HOP ROUTER	DISTANCE	TRANSMISSION PATH MTU	COMBINED PACKET	DISASSEM-BLING ROUTER	NETWORK CONDITION
D	82	2	1500	ACCEPTABLE	83	FAILED
D	87	2	576	ACCEPTABLE	83	NORMAL
⋮	⋮	⋮	⋮	⋮	⋮	⋮

Fig.23

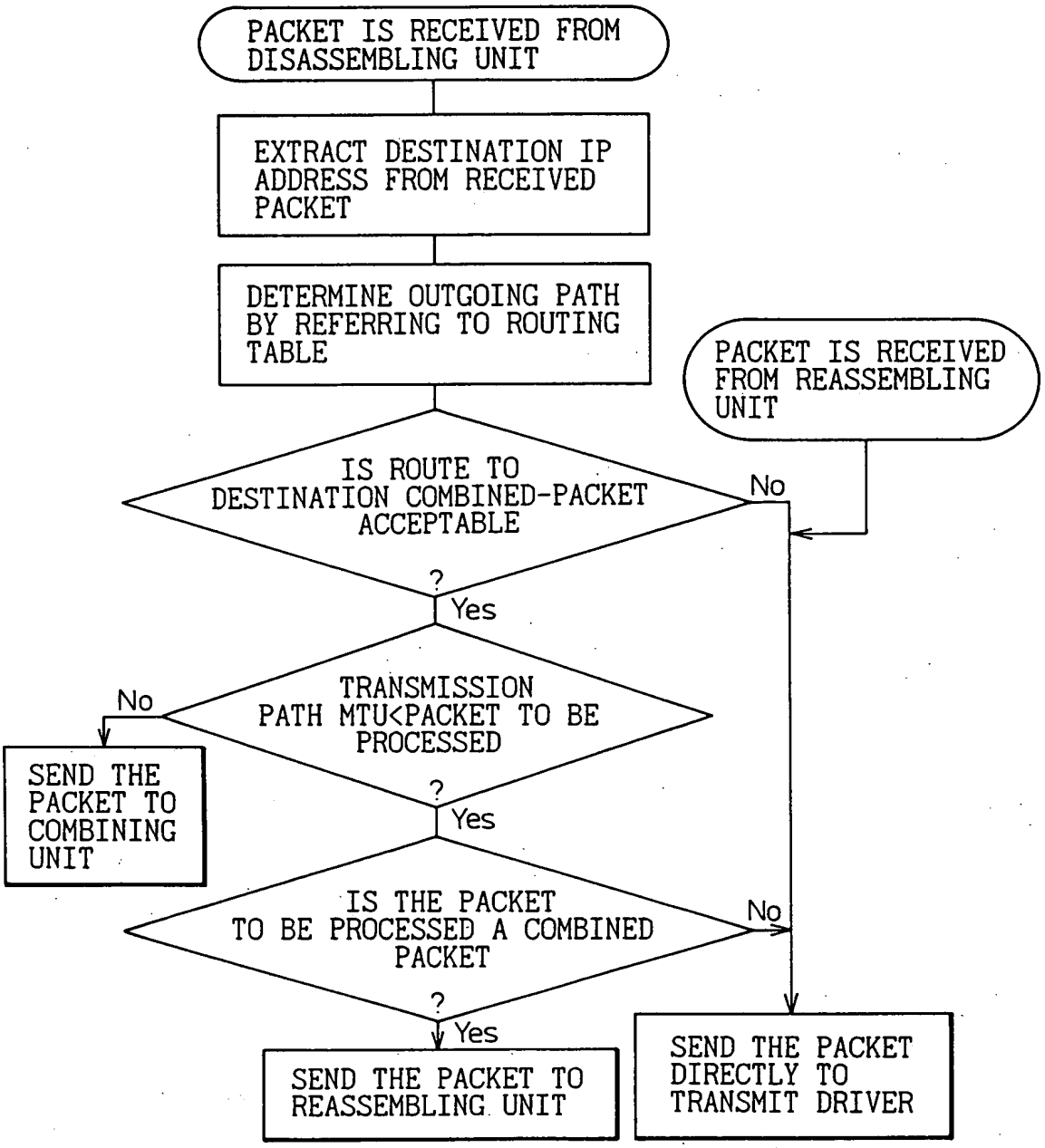

PACKET IS RECEIVED FROM DISASSEMBLING UNIT
EXTRACT DESTINATION IP ADDRESS FROM RECEIVED PACKET
DETERMINE OUTGOING PATH BY REFERRING TO ROUTING TABLE
PACKET IS RECEIVED FROM REASSEMBLING UNIT
IS ROUTE TO DESTINATION COMBINED-PACKET ACCEPTABLE
No
?
Yes
TRANSMISSION PATH MTU<PACKET TO BE PROCESSED
No
?
Yes
SEND THE PACKET TO COMBINING UNIT
IS THE PACKET TO BE PROCESSED A COMBINED PACKET
No
?
Yes
SEND THE PACKET TO REASSEMBLING UNIT
SEND THE PACKET DIRECTLY TO TRANSMIT DRIVER

Fig.24

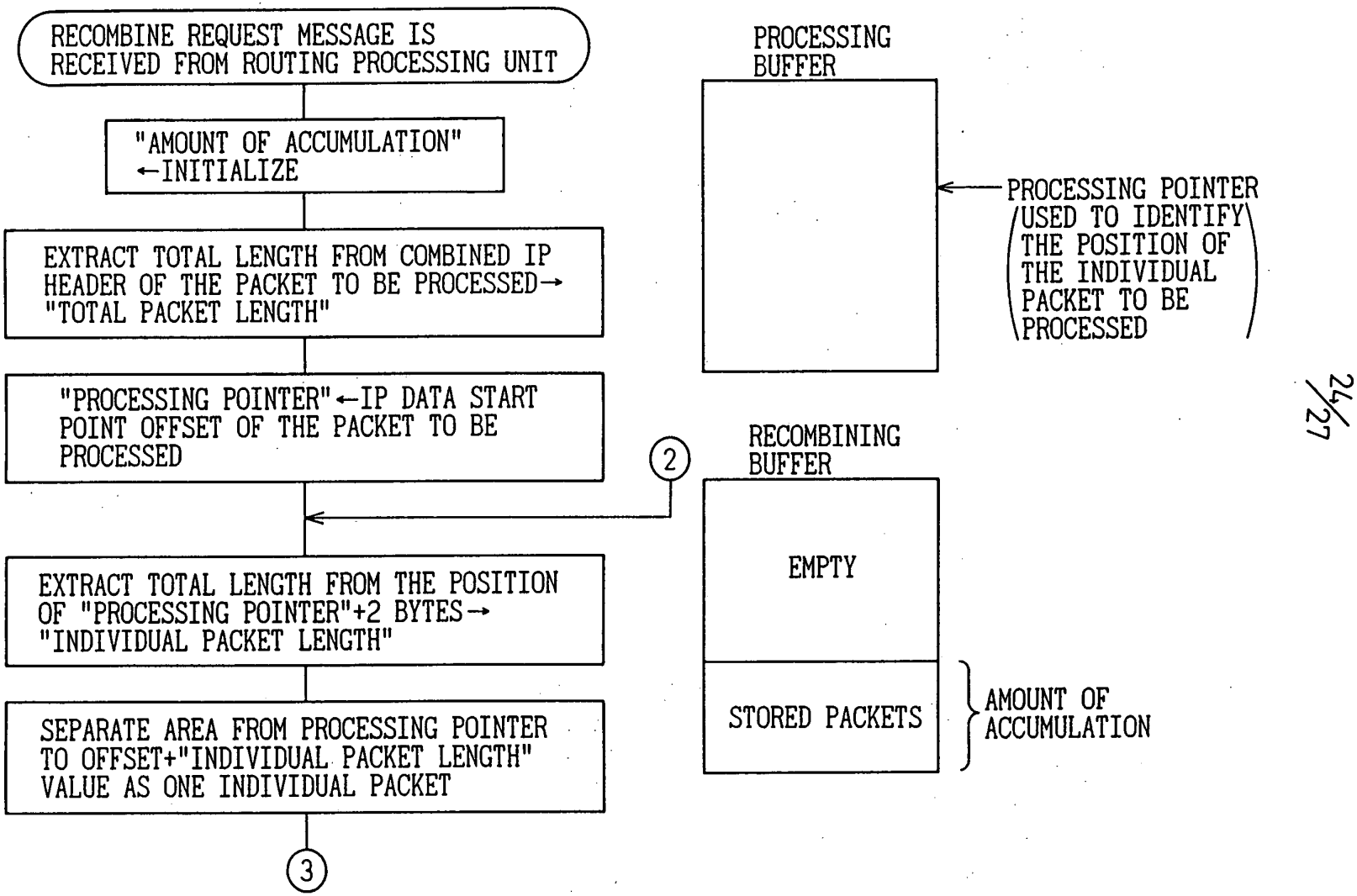


Fig.25

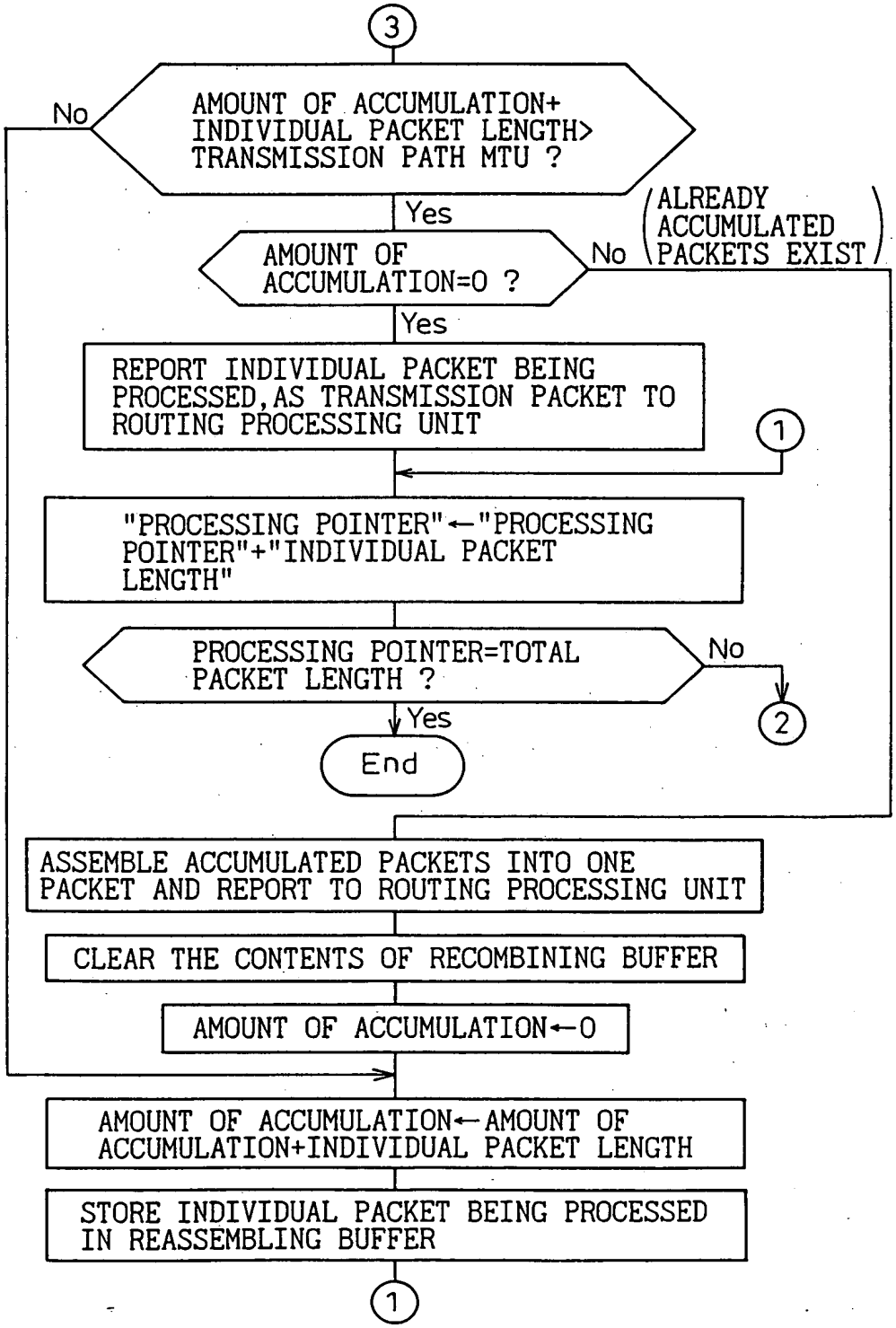

3
AMOUNT OF ACCUMULATION+ INDIVIDUAL PACKET LENGTH> TRANSMISSION PATH MTU ?
No
Yes
AMOUNT OF ACCUMULATION=0 ?
No
ALREADY ACCUMULATED PACKETS EXIST
Yes
REPORT INDIVIDUAL PACKET BEING PROCESSED, AS TRANSMISSION PACKET TO ROUTING PROCESSING UNIT
1
"PROCESSING POINTER"←"PROCESSING POINTER"+"INDIVIDUAL PACKET LENGTH"
PROCESSING POINTER=TOTAL PACKET LENGTH ?
No
2
Yes
End
ASSEMBLE ACCUMULATED PACKETS INTO ONE PACKET AND REPORT TO ROUTING PROCESSING UNIT
CLEAR THE CONTENTS OF RECOMBINING BUFFER
AMOUNT OF ACCUMULATION←0
AMOUNT OF ACCUMULATION←AMOUNT OF ACCUMULATION+INDIVIDUAL PACKET LENGTH
STORE INDIVIDUAL PACKET BEING PROCESSED IN REASSEMBLING BUFFER
1

Fig.26

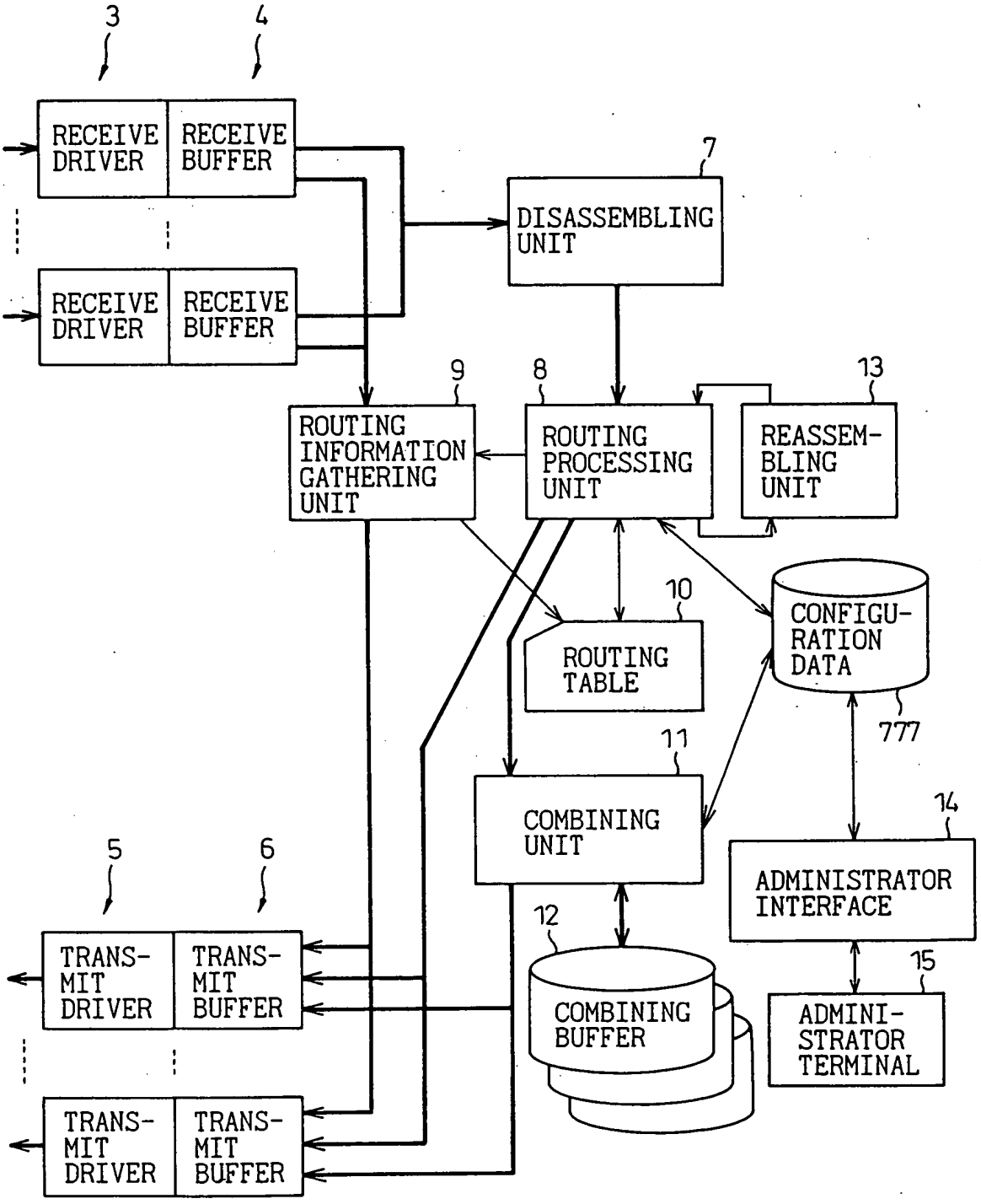
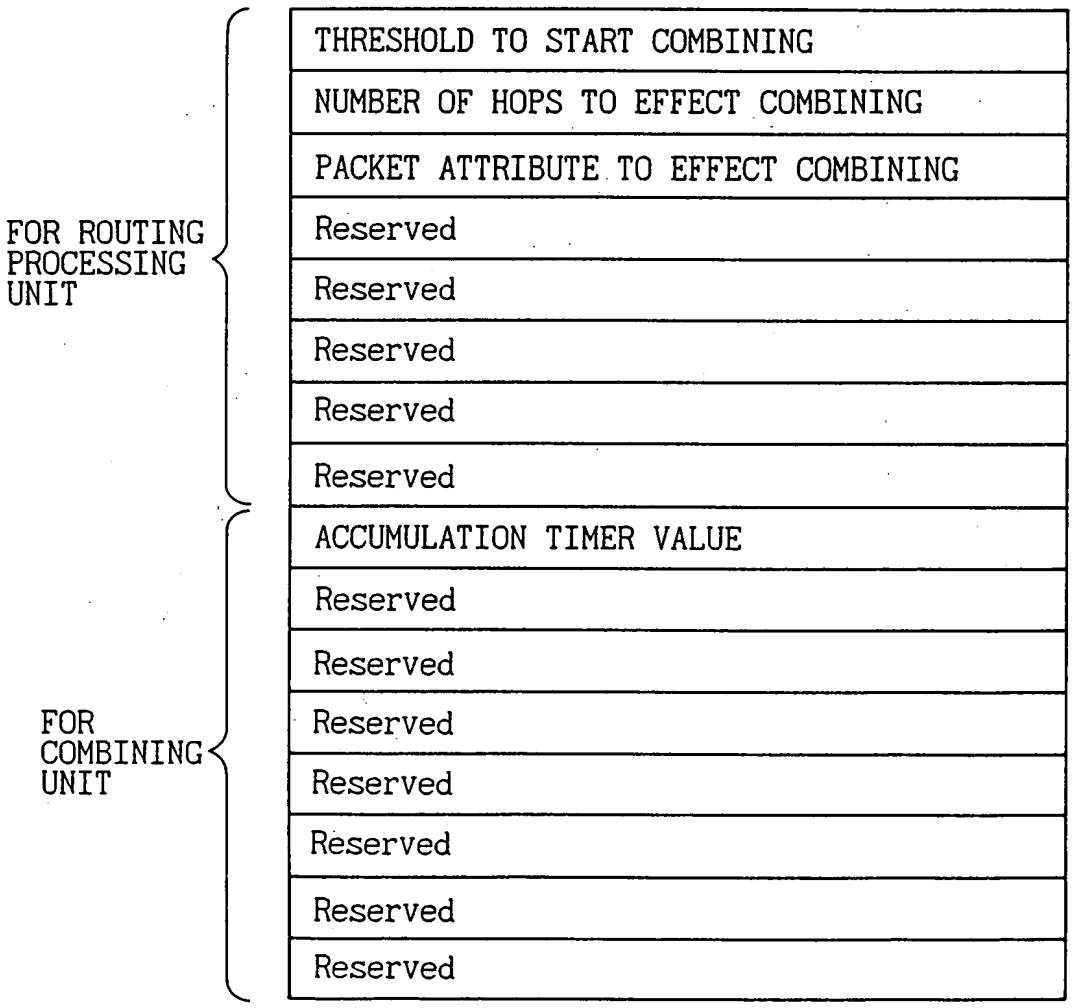

3
4
RECEIVE DRIVER
RECEIVE BUFFER
RECEIVE DRIVER
RECEIVE BUFFER
7
DISASSEMBLING UNIT
9
8
13
ROUTING INFORMATION GATHERING UNIT
ROUTING PROCESSING UNIT
REASSEM-BLING UNIT
10
ROUTING TABLE
CONFIGU-RATION DATA
777
11
COMBINING UNIT
14
ADMINISTRATOR INTERFACE
5
6
12
15
TRANS-MIT DRIVER
TRANS-MIT BUFFER
COMBINING BUFFER
ADMINI-STRATOR TERMINAL
TRANS-MIT DRIVER
TRANS-MIT BUFFER

Fig.27


FOR ROUTING PROCESSING UNIT
FOR COMBINING UNIT
THRESHOLD TO START COMBINING
NUMBER OF HOPS TO EFFECT COMBINING
PACKET ATTRIBUTE TO EFFECT COMBINING
Reserved
Reserved
Reserved
Reserved
Reserved
ACCUMULATION TIMER VALUE
Reserved
Reserved
Reserved
Reserved
Reserved
Reserved
Reserved